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Coulomb failure and slip distribution for the 1997 Umbria-Marche seismic sequence inferred from newly inverted DInSAR data

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The 1997 Umbria-Marche seismic sequence has been widely discussed in published literature, but results, in terms of fault location or slip over the two main faults, give non-unique solutions. Starting from DInSAR vertical deformation measurements over the study area, we estimate both the distribution of slip and fault geographical position. The vertical deformation is obtained from a rigorous procedure applied to coseismic interferogram, in which interferometric DInSAR analysis methods take into account atmospheric effects, DEM and unwrapping errors. This procedure allows us to obtain a high spatial density of measurement points on faulted zone which are used in the procedure for estimating fault parameters. The best-fit model is obtained by minimizing a functional of both misfit and penalty for model roughness and reverse-slip. The position of faults in the direction normal to strike and the relative distance between the two faults in the along-strike direction are well constrained by our inversion scheme, which fails to constrain the position of the two-fault system in the along-strike direction: the displacement of the two-fault system in the along-strike direction brings in fact to different partitioning of the (nearly the same) total seismic moment. This uncertainty in the along-strike direction is overcome by crossing information from geodetic data and previous inferences from seismological analysis on the seismic moment release over the two faults. Our inversion shows that the two fault planes are wider than those previously considered and that the two faults are nearly contiguous. Modelled seismic moment release agree with the one seismologically inferred within the 10% and the discrepancy between vertical deformation data and modelled solution shows a Gaussian-like distribution with a σ of 12 mm, which is two times better than previously proposed models. Distribution of slip and fault location is then used to model static stress changes due to faulting. We calculate Coulomb failure function projected progressively on the faults of the whole main seismic sequence. Our results improve previous findings and show that the main faults are located in volumes of the crust where faulting is promoted.